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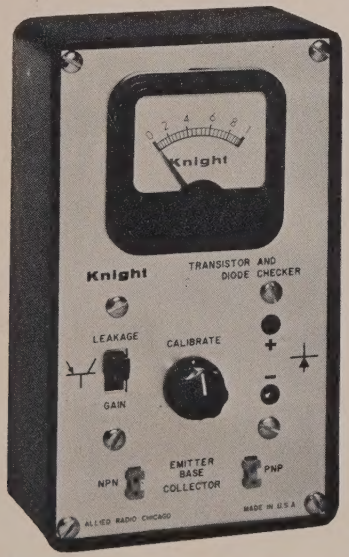


TRANSISTOR AND DIODE CHECKER

83 Y 149

ASSEMBLY MANUAL

A PRODUCT OF ALLIED RADIO · CHICAGO

knight-kit®

SPECIFICATIONS

CHECKS	NPN and PNP Transistors, Germanium and Silicon Diodes, Selenium and Copper Oxide Rectifiers
POWER SUPPLY	Self-contained 22½ V Battery, Burgess U-15; RCA VS084 or Equiv.
METER	0 to 1 ma Dynamometer-type movement
OVERALL DIMENSIONS	6¼" x 3¾" x 2⅝"
APPROX. SHIPPING WEIGHT	2 lbs.

INTRODUCTION

Your Transistor and Diode Checker can be used to check almost all types of semi-conductor devices.

The most important use of this instrument is the checking of the leakage-to-gain ratio of a transistor. This instrument will check the leakage-to-gain ratio for all types of junction and point contact transistors. To check surface barrier transistors, you will have to substitute a 4.5 volt battery in place of the 22½ volt battery supplied. Matched pairs of transistors, whether they be of similar or dissimilar types, can be selected with the aid of your Transistor and Diode Checker.

Germanium and silicon diodes and selenium rectifiers can be checked for excessive reverse current conduction, and for front-to-back conduction ratio.

Another important feature of your Transistor and Diode Checker is that it enables you to listen to the noise generated by a transistor. By making use of this feature, you will be able to select low noise transistors for use in low level stages.

CHECKING YOUR KIT

Before starting to build your Transistor and Diode Checker, check each part against the Parts List on Page 15. This will help you to become acquainted with each part. If you are unable to identify some of the parts by sight, locate them on the pictorial diagrams. To keep our kits at the lowest possible price, we frequently weigh the hardware rather than count it. It is common for more screws or nuts to be supplied than are specified in the Parts List.

CONSTRUCTION HINTS

The only tools required for building your Transistor and Diode Checker are: Long-nose pliers, diagonal cutters, medium size screwdriver, setscrew driver, and a soldering iron. A good set of tools is listed on the Parts List page.

Study the pictorial diagrams and note how the parts are mounted. These pictorial diagrams show the actual location of all parts and wires. The schematic diagram shows how the parts are connected electrically and is helpful in understanding how the circuits work.

The step-by-step instructions were prepared while a skilled technician was actually building the Transistor and Diode Checker. We suggest that you check off each step in the space provided after you have completed it. Some builders also like to put a pencil mark on the wiring as they complete it.

PARTS MOUNTING

SEE FIGURE 2.

☐ Mount J-2, one of the transistor sockets, with a retaining clip. J-2 must be mounted with the two terminals that are close together toward the top of the panel. An exploded view of how J-2 is mounted is shown in Figure 3.

☐ In a similar manner, mount J-3, the remaining transistor socket.

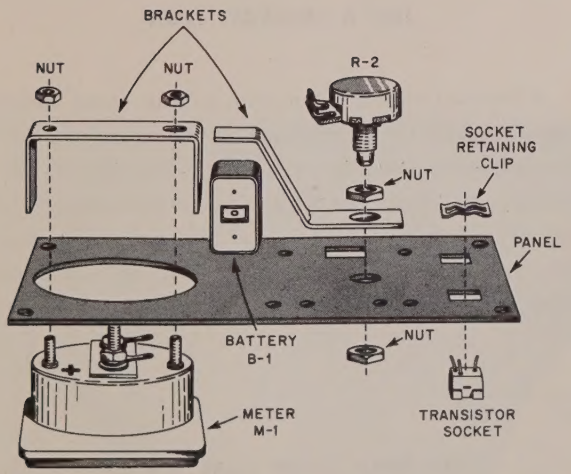


FIGURE 3. EXPLODED PARTS MOUNTING

☑ Mount M-1, the meter, to the panel with the meter mounting bracket and two nuts. One of the mounting holes in the bracket is oblong shaped. The bracket must be positioned with this hole toward the bottom of the panel. Figure 3 shows how the meter is mounted to the panel.

☑ Place B-1, the 22½ volt battery, in position on the panel. The positive (+) terminal must face toward the right edge of the panel.

☑ Mount R-2, the 10KΩ **CALIBRATION** control, and the battery mounting bracket with two large nuts. Refer to Figure 3 for complete assembly details. The terminals of R-2 must be positioned toward the top of the panel.

☑ Mount S-1, the **LEAKAGE-GAIN** switch, with two machine screws. Since the mounting holes of S-1 are threaded, nuts are not required. This is a spring return-type switch, and it must be mounted with the actuating knob toward the top of the panel.

☑ Mount J-1, the two terminal jack, with two machine screws and nuts.

THIS KIT MUST BE PROPERLY SOLDERED!

WITHOUT GOOD SOLDERING, AN ELECTRONIC UNIT WILL NOT WORK . . . just as a suit of clothing will fall apart if the stitches are loose . . . no matter how excellent the material.

USE ENOUGH HEAT

This is the main idea of good soldering. The purpose of soldering is to join metal parts, making an UNBROKEN metal path over which electricity can travel. To do this you must apply enough heat to the metal surfaces to make the solder spread freely on them, until the contour (shape) of the connection shows under the solder. If the solder barely melts and forms a rounded ball, *you are not using enough heat.* If you do not use enough heat, there may be no electrical connection, although it appears soldered.

USE A 100-WATT IRON

A 100-watt soldering iron with a clean, chisel-shaped tip will supply the right amount of heat when used correctly. Notice how the iron is held in the picture. Heat the iron for 10 minutes before you start soldering. Keep the tip brightly coated with solder. When necessary, wipe the hot tip clean with a cloth. (If you use a soldering gun, be sure the tip reaches full heat before you solder.)

USE ONLY ROSIN CORE SOLDER

We supply the right kind of solder *(rosin core solder).* Do not use any other kind of solder! USE OF ACID CORE SOLDER, PASTE, OR IRONS CLEANED ON A SAL AMMONIAC BLOCK WILL RUIN ANY ELECTRONIC UNIT AND WILL VOID THE GUARANTEE.

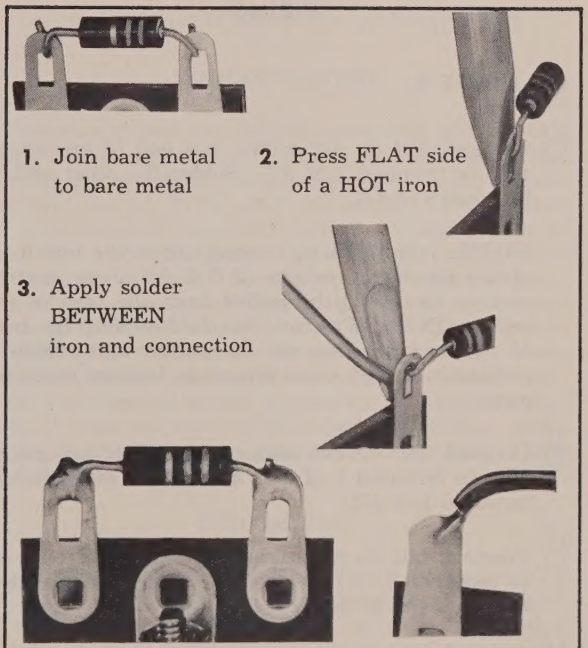
HERE'S HOW TO DO IT . . .

1. Join bare metal to bare metal. Insulation must be removed.
2. Coat the tip of a hot iron with solder.
3. FIRMLY PRESS THE FLAT SIDE OF THE TIP OF A HOT IRON FLAT against the parts to be soldered together. Keep it there while you apply the solder BETWEEN THE IRON TIP AND THE METAL TO BE SOLDERED. Use only enough solder for it to flow over ALL the surfaces of the connection. Remove the iron.
4. DO NOT MOVE PARTS UNTIL THE SOLDER HARDENS. If you accidentally move the wires as the solder is hardening, apply your iron and reheat.

Compare your soldering with the pictures on this page. You have a good connection if your solder has flowed over all surfaces to be connected, following the shape of the surfaces. It should appear smooth and bright.

YOU HAVE NOT USED ENOUGH HEAT: If your connection is rough and flaky-looking, or if the solder has formed a round ball instead of spreading.

The difference between good soldering (enough heat) and poor soldering (not enough heat,) is just a few extra seconds with a hot iron FIRMLY applied. Remember, larger metal surfaces take a longer time to heat.



Compare your soldering with these pictures.

THE ONE-TWO-THREE OF GOOD SOLDERING

WIRING

SEE FIGURE 4.

- [ ] Connect, but do not solder, one end of an orange wire to terminal 1 of J-1. Solder the other end to terminal 3 of J-3.

NOTE: When making connections to the terminals of the transistor sockets (J-2 & J-3), use caution as they can easily be pulled from the base of the socket. DO NOT permit flux to flow onto the base of the socket. Flux on the socket will create a leakage path and cause erroneous leakage measurements.

- [ ] Connect, but do not solder, one end of an orange wire to terminal 1 of J-1. Solder the other end to terminal 1 of J-2.
- [ ] Connect, but do not solder, one end of a red wire to terminal 3 of R-2. Connect, but do not solder, the other end to terminal 2 of J-1.
- [ ] Solder one end of an orange wire to terminal 3 of R-2. Solder the other end to terminal 1 of J-3.
- [ ] Solder one end of an orange wire to terminal 1 of J-1. Connect, but do not solder, the other end to terminal 6 of S-1.
- [ ] Solder one end of a red wire to terminal 2 of J-1. Solder the other end to terminal 3 of J-2.
- [ ] Connect, but do not solder, one end of a red wire to terminal 1 of R-2. Connect, but do not solder, the other end to terminal 3 of S-1.
- [ ] Solder one end of a red wire to terminal 1 of R-2. Solder the other end to the minus (—) terminal of B-1.
- [ ] Solder one end of an orange wire to terminal 2 of R-2. Solder the other end to terminal 1 of M-1.
- [ ] Solder one end of an orange wire to terminal 3 of S-1. Solder the other end to terminal 2 of M-1.
- [ ] Place a ¾" length of spaghetti on one lead of R-1, 220KΩ resistor (red, red, yellow). Solder this lead to terminal 2 of J-2. Place a 1" length of spaghetti on the other lead of R-1. Solder this lead to terminal 2 of S-1.
- [ ] Solder one lead of R-3, 220KΩ resistor (red, red, yellow), to terminal 2 of J-3. Solder the other lead to terminal 5 of S-1.
- [ ] Solder one end of an orange wire to terminal 6 of S-1. Solder the other end to the positive (+) terminal of B-1.

☐ Refer to HOW TO USE THE TRANSISTOR AND DIODE CHECKER (page10) and test the completed checker. Then, install it in the case with four screws. Place the knob on the shaft of the **CALIBRATE** control and tighten the set screw.

TEST LEAD ASSEMBLY

☑ Assemble the test leads as shown in Figure 5.

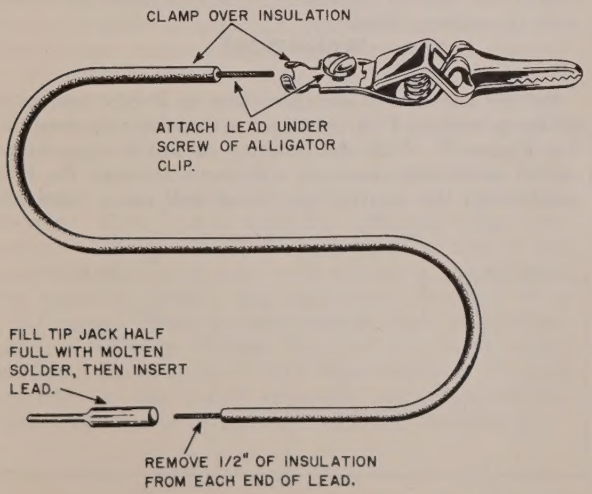

CLAMP OVER INSULATION
ATTACH LEAD UNDER SCREW OF ALLIGATOR CLIP.
FILL TIP JACK HALF FULL WITH MOLTEN SOLDER, THEN INSERT LEAD.
REMOVE 1/2" OF INSULATION FROM EACH END OF LEAD.

FIGURE 5. TEST LEAD ASSEMBLY

SEMICONDUCTORS AND TRANSISTORS

SEMICONDUCTORS

Semiconductors are devices composed of materials (germanium or silicon), which are not conductive enough to be classified as good conductors and are not resistive enough to be good insulators. Certain types of semiconductor materials have an atomic structure with free electrons. These free electrons can be made to move under the influence of an electric field, whereas other types of semiconductor materials have an atomic structure with a deficiency of electrons. An electron deficiency is commonly referred to as a *hole*. Holes will also move when urged to do so by an electric force. The movement of a hole is actually an electron being robbed from an atom to fill a hole in another atom. This, in turn, creates a hole in the atom from which the electron was robbed.

CONDUCTION

Materials that conduct, due to *holes*, are referred to as *P-type* materials. *N-type* materials conduct by the flow of electrons. If a voltage is applied across a P-type or an N-type material alone, they will permit current to flow in either direction. But if a P-type and an N-type material are joined together as shown in Figure 6A, and the voltage is applied as shown, a current will flow between the junction of the two materials. Electrons will be attracted across the junc-

tion through the P-type material and holes will move across the junction through the N-type material. The current, thus, flows through the circuit by holes moving in one direction and electrons moving in the other. If the polarity of the voltage is reversed as shown in Figure 6B, very little current will flow. Therefore, a *junction* of a P-type and an N-type material allows conduction in one direction only and constitutes a *rectifier*.

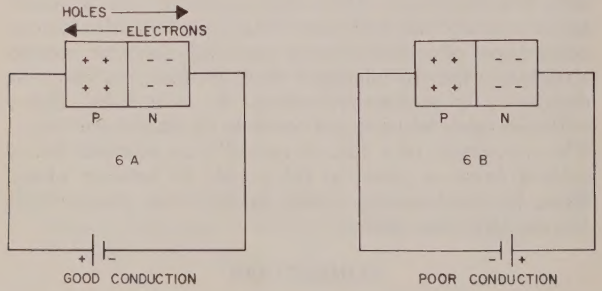


FIGURE 6. P-N JUNCTION

DIODES

This rectifier formed by a junction of a P-type and an N-type material differs from a vacuum-tube diode rectifier in that there is a measurable, although very small, reverse current. The minimum forward current of a typical general purpose crystal diode with 1v applied is 5 ma. Whereas the maximum reverse current with 10v applied is 500μa. Also the crystal diode is small in size, has very low interelectrode capacitance, and requires no heater power as compared to the vacuum tube diode.

Crystal diodes are rated according to their maximum safe inverse voltage and maximum average rectified current. Inverse voltage is the voltage opposite to that which causes maximum current flow. The average current is the current measured by a DC meter in series with the current flow.

TRANSISTORS

By the addition of another piece of P-type material to the preceding P-N junction, a transistor is created. See Figure 7. With the polarity of the voltages connected as shown, electrons will move through the left junction to the emitter and holes will move into the

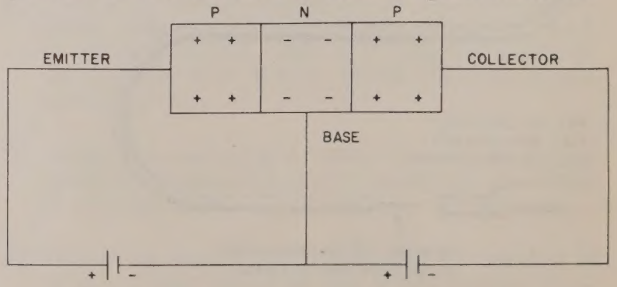


FIGURE 7. A BASIC TRANSISTOR

N-type material. Some of the holes will be neutralized in the N-material, but most of them will get through to the P-type material (collector) on the right. Normally with this P-material biased negative, no current would flow through it; however, there is now a surplus of holes at the junction to travel through it. Most of the current flow is from the emitter to the collector. Very little flows through the common base connection. The collector current, therefore, is controlled directly by the emitter current. Since the collector is biased negatively, it has a *high* collector to base resistance. This resistance is commonly referred to as the output impedance. Likewise, with the emitter biased positively, it has a *low* emitter to base resistance. This resistance is commonly referred to as the input impedance. This means that the collector (high impedance), having almost the same current flow as the emitter (low impedance), will exhibit a power gain. The transistor which has just been discussed is a P-N-P type. There is also another type of junction transistor called an N-P-N. The N-P-N type transistor functions similar to the P-N-P type transistor. Voltage polarities for the N-P-N transistor are connected opposite from the polarities for the P-N-P transistor.

TRANSISTOR CHARACTERISTICS

One of the important characteristics of a transistor is its emitter-to-collector current amplification factor. This amplification factor is designated by α, the Greek letter alpha. Alpha is the important characteristic of a transistor when it is used in a grounded base circuit.

Alpha approaches, but never reaches, a gain of 1 in junction transistors. Another important characteristic of transistors is the base to collector amplification. This amplification is designated by B, the Greek letter, beta. Beta is the important characteristic of a transistor when it is used in a grounded emitter circuit. It is common for junction transistors to have a beta of 30 to 40 while the alpha for the same unit is less than 1. Beta in terms of alpha is approximately equal to $\alpha/(1-\alpha)$. Thus, it is desirable for high amplification to have alpha as near to 1 as possible. The alpha cut-off frequency is another important characteristic of transistors. This is the point where the current amplification drops 3 db below its low frequency value.

HOW TO USE THE TRANSISTOR AND DIODE CHECKER

HOW TO CHECK JUNCTION, POINT CONTACT AND SURFACE BARRIER TRANSISTORS

NOTE: If surface barrier transistors are to be checked, use a 4.5 volt battery in place of the 22.5 volt battery supplied.

A. Determine from the manufacturer's literature if the transistor is a PNP or an NPN. Manufacturers' data sheets for many transistors are available on request from:

Allied Radio Corporation
100 N. Western Ave.
Chicago 80, Illinois

B. Insert the transistor into the appropriate socket.

C. Press the **LEAKAGE-GAIN** switch to **GAIN**, and adjust the **CALIBRATION** control until the meter indicates 1 on the scale. Some transistors will not indicate 1. In this case, adjust the **CALIBRATION** control for maximum reading.

D. Release the switch and read the leakage current of the transistor.

E. If the leakage current is less than the gain current, the transistor will amplify.

How To Interpret Your Readings

If the leakage current does not exceed the gain current, the transistor will amplify. But as the ratio between the gain and leakage currents increase, so does the potential current gain of the transistor. The above statement holds true only when the transistor is used in a properly designed circuit that matches the output impedance of the transistor.

A transistor that does not give any indication is open circuited. A transistor that shows an excessively high leakage current and does not indicate any gain, is short circuited. So a transistor is *bad* if the leakage current exceeds or equals the gain current, if it is short circuited or if it is open circuited.

If several transistors of the same type and of the same manufacturer are checked, you will more than likely find that their leakage and gain currents vary over a wide range. By checking several transistors you should be able to select one with a suitable impedance to match a particular circuit. If the leakage and gain currents are both high, the transistor has a low output impedance. On the other hand, if the leakage and gain currents are both low, the transistor has a high output impedance.

SELECTING MATCHED PAIRS

A matched pair of transistors can be selected by checking several transistors and recording their leakage and gain currents. When checking transistors to find a matched pair, do not disturb the setting of the **CALIBRATION** control after the initial adjustment. A matched pair is two transistors that have the same or nearly the same leakage and gain currents. A matched pair can be two of the same type, both PNP or both NPN, or they can be of different types, one PNP and one NPN. It is a good idea to select a matched pair when transistors are to be used in a push-pull circuit. If two units of the same type are used, out of phase signals are required to drive them. But if a PNP and an NPN are used in a push-pull circuit, out of phase signals are not required.

SELECTING LOW NOISE TRANSISTORS

A. Insert the transistor into the appropriate socket.

B. Press the **LEAKAGE-GAIN** switch to the **GAIN** position and adjust the **CALIBRATION** control until the meter indicates 1 on the scale. If a transistor will not read as high as 1, adjust the **CALIBRATION** control for maximum.

C. Plug the leads of a pair of crystal headphones (a pair of sensitive magnetic headphones with a .05 mfd capacitor in series with one of the leads can be used) into the double phone jack. A signal tracer or an audio amplifier can be used in place of the headphones.

D. With the **LEAKAGE-GAIN** switch in the **LEAKAGE** position, you should be able to hear the noise generated by the transistor. If a number of transistors are to be compared, the **CALIBRATION** control must be set for each transistor.

CHECKING SELENIUM AND COPPER OXIDE RECTIFIERS

CHECKING THE FORWARD-TO-REVERSE CONDUCTION RATIO

A. Connect the negative lead of the Checker to the positive terminal of the rectifier to be checked. Connect the positive lead to the negative terminal. This biases the rectifier in the forward direction.

B. Adjust the **CALIBRATION** control until the meter indicates 1 on the scale.

C. Reverse the connections to the rectifier and note the deflection of the meter. The rectifier is now biased in the reverse direction. Most good rectifiers will cause only a very small meter deflection when biased in the reverse direction.

D. A multiple plate rectifier that exhibits a 20:1 forward to reverse conduction ratio is considered good for this test.

CHECKING SELENIUM AND COPPER OXIDE RECTIFIERS FOR FORWARD VOLTAGE DROP

A. Short the two test leads of the Checker together and adjust the **CALIBRATION** control until the meter indicates 1 on the scale.

B. Connect the negative lead of the Transistor and Diode Checker to the positive terminal of the rectifier. Connect the positive lead to the negative terminal.

C. Rectifiers that are rated at 65 ma or less should read at least 90% of full scale deflection. Rectifiers rated at more than 65 ma should read at least 95% of full scale deflection. Rectifiers that do not meet these specifications have a high internal resistance and should not be used.

How To Interpret Your Readings

The worth of a rectifier depends on its ability to pass current in one direction only. Therefore, a rectifier that has a high reverse current will not serve the purpose for which it was intended. Also, a rectifier must have a low internal resistance when biased in the forward direction. If the internal resistance is high and the rectifier is used in a circuit, the voltage supply will be lower than normal. A rectifier that does not give any indication, when connected to the tester so as to bias it in the forward direction, is an open circuited rectifier. Likewise, a rectifier that gives a substantially large indication, when biased in the reverse direction, is a short circuited rectifier. A rectifier must pass both the forward to reverse conduction ratio and the forward voltage drop tests to be considered good.

HOW TO CHECK GERMANIUM AND SILICON DIODES

A. Connect the negative lead of the Checker to the cathode lead of the diode. The cathode of a diode is usually marked with one of the following: A band, a dot, or a K. Connect the positive lead to the other lead of the diode.

B. Adjust the **CALIBRATION** control until the meter indicates 1 on the scale.

C. Reverse the connections to the diode and note the meter deflection. Most good diodes will cause only a very small unreadable meter deflection when connected so as to bias it in the reverse direction.

D. A diode that exhibits at least a 50:1 forward to reverse conduction ratio is considered good.

How To Interpret Your Readings

The worth of germanium and silicon diodes depends on their inherent ability to pass current in one direction only. Therefore, a diode that has a high reverse current will not serve the purpose for which it was intended. If the forward to reverse conduction ratio does not meet the 50:1 ratio test, the diode should be discarded. The reverse current for most diodes is unreadable.

Video detector and other high conduction diodes are good if the forward to reverse conduction ratio is at least 10:1. These diodes will usually cause a readable reverse current meter deflection.

CIRCUIT DESCRIPTION

A simplified schematic of the Transistor and Diode Checker with the **LEAKAGE-GAIN** switch in the **LEAKAGE** position is shown in Figure 8. Note that the base lead of the transistor is floating for the leakage test. The current that flows in the collector is a function of temperature, the resistivity of the germanium and the applied voltage. Any contamination on the surface of the germanium or a short circuit will be indicated by a high reading on the meter.

Closing switch S-1 (the **LEAKAGE-GAIN** switch) applies voltage to the base through the 200KΩ resistor. The collector current of a good transistor will show an increase. The amount of increase is determined by the quality as well as the beta of the transistor. The **CALIBRATION** control provides a means of adjusting the amount of collector current that flows through the meter. The collector current, flowing through the meter with S-1 in the **GAIN** position, usually can be adjusted so that the meter indicates full scale deflection. With the **CALIBRATION** control set for full scale deflection, the leakage to gain ratio of the transistor can be determined.

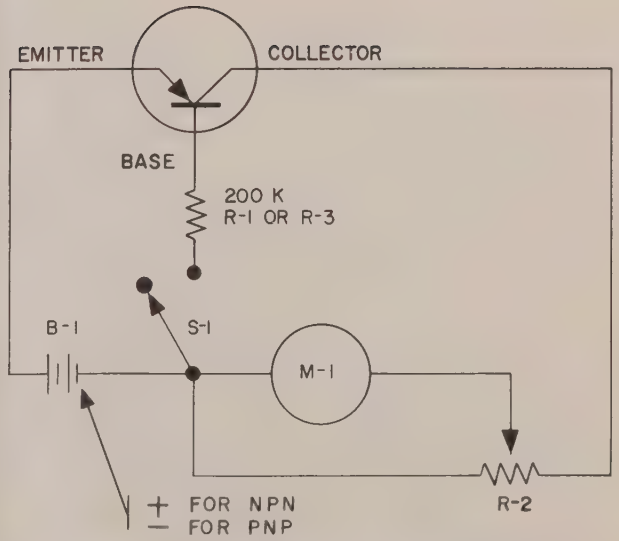


FIGURE 8. SIMPLIFIED SCHEMATIC DIAGRAM

SERVICE HINTS

To check the battery, connect the test leads of the Checker across a 15KΩ resistor. If the meter does not indicate full scale deflection, with the **CALIBRATE** control fully clockwise, replace the battery.

Never leave a low or run-down battery remain in your Checker as it may leak and damage the wiring.

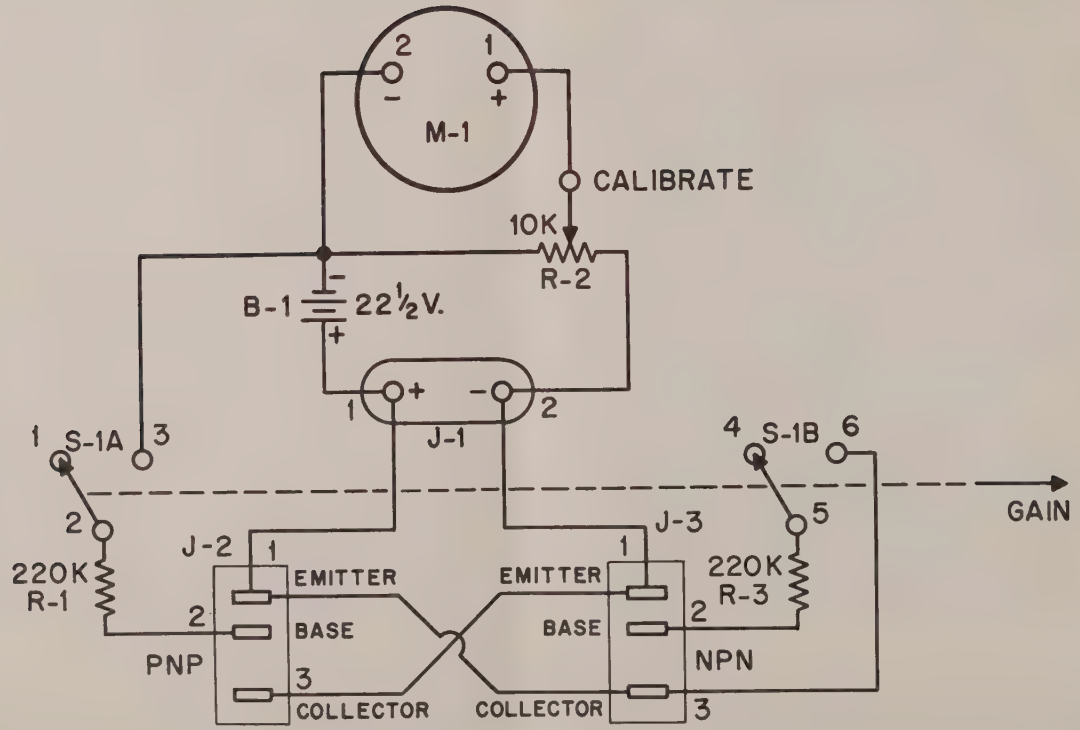


FIGURE 9. COMPLETE SCHEMATIC DIAGRAM

PARTS LIST

Symbol Number	Description	Part No.
NOTE:	When ordering resistors, give complete description and part number.	
R-1	Resistor, 220 KΩ, ½W, 5%	302224
R-2	Calibration Control, 10KΩ	390112
R-3	Resistor, 220KΩ, ½W, 5%	302224
B-1	Battery, 22½ volt	450220
J-1	Jack, double pin-plug	502227
J-2	Socket, transistor	501230
J-3	Socket, transistor	501230
M-1	Meter, 0-1 MA: with hardware	652204
S-1	Switch, DPDT, Spring return	431302

Description	Qty.	Part No.
Bracket, battery	1	470067
Case, plastic	1	701005
Clip, alligator	2	532005
Clip, retaining: for transistor socket	2	532016
Knob	1	761001
Manual	1	750062
Nut, hex: 3/8" x 32	2	570840
Nut, hex: 6-32	2	570340
Panel, front	1	462606

Description	Qty.	Part No.
Pin plug	2	502110
Screw, machine: 6-32 x ¼"	8	560342
2" wire, red	4	801002
3" wire, orange	7	801003
18" test lead: black	1	804017
18" test lead: red	1	804018
3" Spaghetti	1	812001
6" Solder		930001

TOOLS NEEDED FOR CONSTRUCTION

Stock No.	Description	Price*
46 N 852	Soldering iron	$5.16
50 N 132	6" long-nose pliers	1.54
50 N 133	5" diagonal cutters	1.34
45 N 796	6" screwdriver	.72

*Subject to change

ALLIED'S SERVICE FACILITIES

If the kit does not operate properly, we recommend the following:

Please write our Kit Department giving the stock number and date of purchase of the kit. Also, describe fully what appears to be wrong. Details as to which controls or sections of the circuit do not function properly will help us analyze the problem. We may be able to determine a wiring error or a defective part.

This wired KNIGHT kit may be returned for inspection within one year after purchase for a special service charge of $2.00. However, if the meter must be replaced because of burnout or other abuse, another $3.72* will be charged. Parts within the standard EIA 90-day warranty period will be replaced without charge for the parts. A charge will be made for parts damaged in construction or because of a wiring error, or for parts which are beyond the 90-day warranty period. After the one-year period, service charges are based on the length of time required to repair the unit plus the cost of any new parts that may be needed.

PLEASE NOTE: KITS SOLDERED WITH ACID CORE SOLDER, ACID FLUX OR IRONS CLEANED ON A SAL AMMONIAC BLOCK ARE NOT ELIGIBLE FOR REPAIR OR SERVICE AND WILL BE RETURNED NOT REPAIRED AT YOUR EXPENSE.

Allied's service facilities are primarily for inspection and trouble-shooting. Kits not completely wired, which require extensive work, will be returned collect with a letter of explanation.

If you return this kit, pack it well. To prevent damage in shipment, use a large enough carton so that cushioning material can be placed around the unit. (Do not use the carton in which the kit was packed.) Cushion it well and tightly. Mark the carton, "FRAGILE—DELICATE ELECTRONIC INSTRUMENT." Send the kit prepaid and insured. We will return the repaired kit to you C.O.D. as soon as repairs are completed. If you wish to save C.O.D. fees, your advance remittance may be enclosed to cover the standard repair charges plus transportation costs. Any excess money will be refunded.

ALLIED'S GUARANTEE ON KNIGHT KITS

The designs and components selected for KNIGHT kits represent over a quarter of a century of experience in kit development. KNIGHT kits are easy to assemble even for a beginner. The instructions are complete, panels are drilled, the chassis is punched and formed, and every part is included as listed.

Allied extends these firm guarantees on KNIGHT kits:

We guarantee that the circuits in all KNIGHT kits have been carefully engineered and tested.

We guarantee that only high-quality components are supplied. All parts are covered by the standard EIA 90-day warranty. Any faulty components will be replaced prepaid and without charge if reported to us within the warranty period. We reserve the right to request the return of defective parts.

If your kit was shipped by parcel post and is received in a damaged condition, please write us at once describing the state in which the shipment was received. If your kit was part of a Railway Express shipment that was damaged in transit, please notify the Railway Express agent at once and then write us.

The efficiently engineered KNIGHT kits are moderately priced. When you buy a KNIGHT kit you get the best in design, quality, and value. Recommend KNIGHT kits to your friends.

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